and also suggests any other diagnostic tests that seem to be indicated.

Dr Gilbert would like to see similar carrel units set up throughout Honolulu and elsewhere, so that all physicians can have testing facilities near their offices. He says the carrels in his clinic are "suitable for both large and small populations and can be fixed or mobile. I believe they set the direction that most multiphasic screening units will take in the next few years."

The Hawaii Carrel—A Modular Approach to Multiphasic Screening

Fred I. Gilbert, Jr, MD

Reprinted from *Proc Int Congr Group Medicine.* 1970; Apr 26-30; 276-278.

This presentation is a review of the developments of multiphasic screening for chronic disease as conducted in the multispecialty group practice that I am associated with in Honolulu, Hawaii. My personal interest in this field began in 1951, shortly after I joined the Straub Clinic. I found that along with a number of my colleagues, especially in the fields of general practice, internal medicine, and pediatrics, I was spending approximately 25% of my time caring for the well rather than the sick. Also, I observed that most of us approached the examination of the apparently well in much the same manner that we dealt with the obviously sick. We did what we were taught to do in medical school. We would record the chief complaint, family history, past and present illnesses and perform a physical examination and then order certain laboratory procedures. Diagnoses were arrived at after the results of the laboratory tests were known and then certain recommendations were made. We physicians who were actually doing these examinations frequently found ourselves functioning more like clerks and machines than as physicians. Repetitively going through various diagnostic maneuvers and sorting through piles of normal laboratory reports does not sharpen diagnostic abilities. In short, the periodic health appraisal examination, as was conducted during that era, wasted considerable time of both the physician and the patient. In 1951, we introduced the Cornell Medical Inventory[1] to Honolulu. This saved some of the physician's and patient's time by permitting, prior to the examination, a systematic review of past medical history and recent symptoms. The patient still had to go from place to place to get his or her various x-ray, laboratory tests and other procedures done and the physician still had to conduct his or her physical examination in the traditional manner and collate all of the increasing mass of medical information generated at the time of the health appraisal.

By 1953, we felt that we had given sufficient thought to the matter to permit us to try a different approach. We selected the Hawaii State Fair as a test site for our hypothesis and set up a

booth to give free tests to anyone who requested them. We included such procedures as chest x-ray, EKG, hemoglobin, white blood count, vision and even blood typing. Although this was an operational success, it had one major defect: It was directly linked to primary patient care. It presented the physician with the results of a number of unsolicited tests, which, in some cases, indicated the possible presence of a condition which had in fact been under treatment for several years. This experience led to the conclusion that if multiphasic testing were to be of real value, it had to be done close to the mainstream of medical care and should be conducted close to the physician or group of physicians responsible for the comprehensive care of the individual. The physician responsible for the patient's care should have much to say about who is to undergo multiphasic screening, what tests are to be done, and how often the tests are to be performed.

Throughout the 50s and 60s, we also watched with interest the progress of Dr Morris Collen[2-3] who was refining multiphasic screening techniques at the Kaiser Hospital in Oakland, California. He introduced two very important factors during this period: Automation of multiphasic testing equipment and improved quality of the examination.

In 1966, with the assistance of a National Institute of Health grant,[4] we were able to further define our concepts of what we thought multiphasic testing should be. Although we admired Dr Collen's achievement and borrowed many of his ideas, we took a slightly different pathway in our design of a multiphasic screening center.

The Kaiser Multiphasic Health Screening unit is the prototype for a number of units including the four large U.S. Public Health Service centers. It is designed basically as a multistation semi-automated multitest laboratory, which is dependent upon a large volume of patients for efficient operation. Our approach in Hawaii differs in two respects. First of all, we substituted modules for multiple stations,and we utilized specially trained registered nurses to perform the physical examination at the time of the screening procedures. This approach made it possible to conduct multiphasic examinations without large patient volume and to present a report to the physician that included a screening physical examination with a tentative statement of the medical problem and a suggested solution. Several improper uses of other professional personnel soon became evident. While we were using the clinician's time more effectively, we were wasting the cardiologist's and roentgenologist's time in reading routine EKGs and chest x-rays. (The pathologist had long ago anticipated us by having a technician screen Papanicolaou tests of the cervix for the presence of abnormal cells). We therefore started a program to train technicians to screen EKGs and chest x-rays for deviation from normalcy. Thus far, one technician has read over 5,000 chest x-rays with a missed lesion error of 5.4% on the last 1,300 reviewed. This compares favorably with two similarly trained technicians in California who missed 4% and 8% respectively. Staff radiologists at the University of California Medical School missed 6% of known lesions.[5]

One of our technicians has read over 10,000 EKGs over the past two years with less than 17 missed abnormal records in the last 250 reviewed. Review of 1,000 consecutive physical examinations performed by registered nurses and MDs[6] revealed the registered nurses performed as well as the MDs except in one area. In auscultation of the heart, the registered nurses heard three times more faint high-pitched systolic murmurs than the MDs (audiograms performed on the registered nurses in their 20s and MDs in their 40s and 50s revealed that all of the MDs had high-frequency-hearing defects.)

The registered nurses incidentally also take a cervical smear at time of bimanual palpation of the pelvic structures. Richard Anema, a former army corpsman, has been trained by Dr James Cherry of the surgical department, to perform routine sigmoidoscopies and now is undergoing training to do gastroscopy.

A high school graduate can be trained to operate all of the diagnostic hardware utilized in multiphasic screening in three to six months and a registered nurse can be trained to perform a screening physical examination in the same period of time. Quality control must be an integral part of multiphasic screening and with diagnostic technicians, registered nurses and physicians, is accomplished by peer review and consultations.

Just as the diagnostic technicians have advanced from merely running the diagnostic hardware to giving a screening interpretation of the tests such as EKG and chest x-rays, the registered nurses in the health appraisal center are now directly managing the care of patients with high blood pressure and obesity, and will soon care for patients with other chronic diseases such as diabetes and arthritis. The physician's role in the nurse management of patients with chronic diseases is one of programming the protocol to be followed and availability for consultation by the registered nurse or patient.

In our unit the cost of the examination varies from $15 to $50 dependent upon the age and sex of the patient, and procedures performed.

The medical data is fed into a computer (IBM 360/30) via punch card, stored on magnetic tape and printed out in a format similar to that of a traditional medical work-up. We are presently using a linear off-line data system but in August of this year will convert to a branching on-line data system.

In summary, by appropriate use of specially trained technicians, registered nurses and physicians; a high quality, computer stored modular multiphasic examination can be performed in a clinical setting with high and low patient volume for an average cost of about $30.

References

1. Brodman K, et al, Cornell Medical Index Health Questionnaire: Adjunct to Medical Interview, *JAMA* 1949.;140:530-534
2. Collen, MF, Periodic Health Examinations Using an Automated Multitest Laboratory, J.A.M.A. 1966;195:142-145.
3. Cohen, MF, et al, Cost Analysis of a Multiphasic Screening Program, New *Eng J Med* 1969;280:1043-1045.
4. The research activities of this project were supported in part by a grant (99021) from the National Institute of Health, Periodic Examination of Apparently Well Individuals.
5. Sheft D et al, Screening of Chest Roentgenograms by Advanced Roentgen *'Technologists, Work in Progress* 1970;94:427-429.
6. Kaku K, The Extended Role of the Registered Nurse in the Multiphasic Screening Unit (in press).